MOBILIZING CHANGE IN AN INDUSTRY NETWORK FOR COMMERCIALIZING A SUSTAINABLE INNOVATION

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ABSTRACT

The development and diffusion of sustainable innovations are of interest to variety of actors, including actors from both public and private sectors. However, the mobilization of change in industry networks that can facilitate the commercialization of such innovations has remained an under-researched area. Therefore, this study examines what triggers the change in existing industry networks that facilitates the commercialization of a sustainable innovation. Qualitative research methods are employed to explore the research phenomenon of interest in the empirical context of food packaging, for which a new bio-based biodegradable plastic packaging material is introduced. As a result, this study identifies first-, second- and third-phase triggers that first create the emerging and then the growing market for the sustainable innovation. A multitude of connections exists between these triggers, but structural triggers in the first phase and agency triggers in the second phase are critical in making the transition to happen and new practices to emerge.

Keywords: change; established industry network; sustainable innovation; sustainability transition

INTRODUCTION

Sustainable development and protecting the possibilities of present and future generations to meet their needs create challenges for societies and businesses. Thus, there is a great societal interest to support the development and diffusion of sustainable innovations. Such innovations include product categories that seek for remarkable sustainability impacts in the future, for example, through sustainable raw materials or environmental-friendly disposal.

Sustainable innovations are of interest of variety of actors, including policy makers, firms and research institutions and innovation systems. Indeed, because of their great societal impact, sustainable innovations are often created in publicly funded R&D project networks that include variety of innovation partners from both public and private sectors. The challenge with such networks however is the management of the transition toward a growing and business-driven commercialization and diffusion network in an industry with existing industry regimes and established and powerful actors. The commercialization process is problematic, especially as research institutions tend to lack required resources and insights into the market and customers, and the skills for further product and business development (e.g., del Campo et al., 1999). Thus, more research on sustainability transitions; how the change happens and is triggered, is needed (Köhler et al., 2019) to increase the understanding of sustainable innovations and how they are brought to the market (Smith, Voss and Grin, 2010).

The change towards sustainable systems can be initiated at the firm level, from which the change is suggested to spread wider, especially if more powerful actors become involved in the change (Köhler et al., 2019; Smith et al., 2010). Innovator actors can thus take intentional actions to advance the commercialization (e.g., Aarikka-Stenroos, Sandberg and Lehtimäki, 2014). However, in commercializing sustainable or any kind of innovation, it is argued that actors need the support of the surrounding network (Aarikka-Stenroos et al., 2014). It is thus critical for a network of actors to cooperatively build an environment that is favorable for their sustainable invention (Planko et al., 2015) in order to reach real sustainability impacts (Adams et al., 2016; Smith et al., 2010). Therefore, as the existing literature has tended to highlight the role of individual firms in the change towards sustainable solutions (Köhler et al., 2019) as well as in innovation diffusion (Aarikka-Stenroos and Sandberg, 2012), more research taking a wider network approach is needed to understand the mobilization of change in industry networks (Aarikka-Stenroos and Sandberg, 2012) that can facilitate the commercialization of sustainable innovations and further industry-wide sustainability transitions.

This study addresses the identified research gaps in the sustainable innovation research by answering the following question: *What triggers the change in existing industry networks that facilitates the commercialization of a sustainable innovation?* Theoretically, the literature on sustainable innovations and change in industry networks is utilized. Qualitative methods are further employed to empirically examine the research phenomenon of interest in the context of food packaging. The study contributes first to the discussion of sustainability transitions and then commercializing sustainable innovations.

SUSTAINABLE INNOVATIONS

Sustainable innovations refer to improved processes, products, services, organizational and marketing methods that reduce negative or increase positive economic, environmental and/or social impacts (Aka, 2019). Advancing the development of such innovations has been at the agenda for policy makers for a good time, but also firms have increasingly been given a central role in advancing the sustainable development (Lupova-Henry and Dotti, 2019). However, instead of arguing on who should act as the key actor in achieving sustainability goals, in recent literature, there has been a call for emphasis on how sustainable innovations can be enhanced in collaborative networks consisting of actors from both public and private sectors (Lupova-Henry and Dotti, 2019).

For sustainable innovations, the combining of ecological and social concerns alongside with economic aspects creates further challenges in terms of innovation management (Adams et al., 2016; Silvestre and Tïrca, 2019). Especially in research-based sustainable innovations, complex interaction between actors from both business and non-profit sectors with different institutional logics might bring challenges and even hinder the commercialization (Watson, Wilson and Macdonald, 2020). Involving different stakeholders and knowledge management can however provide a mechanism to promote sustainable innovations (Ayuso et al., 2011). For example, end-customers' role in sustainable innovations has been acknowledged but from the policy perspective their role has mostly been seen as informed customers that are bound to adopt the innovations and generate demand for them (Nielsen, 2020). However, for sustainable innovations to diffuse, it is important to understand that such processes are evolving co-created processes that involve actor-to-actor orientation instead of producer-user orientation (Trischler, Johnson and Kristensson, 2020).

At the organizational level, innovations towards sustainable development are supported by organization's market sensing capabilities and related organizational routines that enable the constant scanning of the business environment to identify technologies, trends and market demands of their business activities (Mousavi, Bossonk and van Vliet, 2018). Sustainable innovation can be framed through organization's ability to establish mutual relationships with stakeholders and capacity to manage the acquired stakeholder knowledge and transform this into innovation that benefit the society (Ayuso et al., 2011).

In business-non-profit collaboration for sustainable innovation, mechanisms of achieving value outcomes include, not only partners securing their own interests, but also recombining of assets and capabilities to create value for partners, society and environment as well as navigating differences between institutional logics to enhance shared value (Watson et al., 2020). In addition, actors involved in sustainable innovations and related business model development, may have differing views on value created through the innovation, diverging interests as well as varying views on division of risks and responsibilities between the actors (Vleter et al., 2020). The diffusion of sustainable innovations is an ongoing process that relies on ecosystem actors integrating resources into a constantly evolving value proposition (Trischler et al., 2020). Sustainable innovations have thus been recognized as processes that

take time and involve multitude of interactions between various actors of the related network and thus also temporal and relational aspects require attention in research (Aka, 2019).

CHANGE IN INDUSTRY NETWORKS

The network view provides a useful starting point to study change in industry networks as it emphasizes the interdependence of actors, activities and resources as a major force of change (e.g., Håkansson and Johanson, 1992). Ojansivu, Hermes and Laari-Salmela (2020) review the industrial networks literature broadly and identify three approaches that view change from different perspectives: agency, structure and practice. Although we acknowledge that the three approaches are influenced by different ontological premises (Ojansivu et al., 2020), they are utilized in this study as instrumental perspectives in order to provide a comprehensive, tentative framework for studying the phenomenon.

First, *agency approach* views change in business relationships via interaction processes initiated by humans. This view emphasizes individuals as self-contained and self-motivating human agents who influence and change their external environment. The units of analysis are individuals, their relationships, shared ideas and interpretations of the social world. However, there are debates in the industrial network literature on whether actors relate to individuals or firms (Ojansivu et al., 2020). In relation to the agency approach, network dynamics can be understood in terms of actors aiming to change their position in network and the networking behavior in relation to the roles the actors undertake (Abrahamsen, Henneberg and Naudé, 2012). In the context of this study, the role refers to the actor's position in the food packaging industry value network. However, the ability of an actor to change their position is dependent on shared interpretations of roles between different actors in the network. Therefore, network dynamics can be perceived as a process where role perceptions are shaped by mutual understanding of interaction and, perhaps more importantly, by actors challenging the current understanding by bringing in new ideas as to how to organize the network and redefine the roles. In our study, we utilize the agency approach to identify triggers related to actors who take action, resulting in change in the network, which in turn supports the commercialization of the sustainable innovation. Here the "actor" refers to both individuals and organizations, since the individuals eventually form organizations, societies and the mass of consumers.

Second, *structure approach* "dehumanizes" the business relationship by prioritizing structure over individual choice. Here change originates from structures and can be seen as reaction to technological developments as well as market and wider network influences. Unit of analysis in the structure approach is on institutional mechanisms that specify the relationship between antecedent conditions and their consequences. In relation to this approach, Halinen, Salmi and Havila (1999) identify "critical events" as triggers of changes in business networks. However, it is not the event itself that is critical but the way the actors in the network interpret it and react to it. Thus, the actions taken within business relationships and the degree to which these actions are received and acted upon in other connected relationships, determine whether changes occur in business networks. Critical events may arise from interaction in the dyadic relation and/or from general economic, political, social and technological conditions. Although environmental forces seem to have a more general level impact on networks, it is important to

notice that they are always transmitted within the network through individual relationships. An incremental change in a dyad can trigger dramatic changes in the business network if the small initial change is perceived as critical by other actors, and the other way around; incoming incremental impulses from the network may lead to radical dyadic change. In our study, we employ structure approach to identify triggers that emerge beyond the direct influence of the explored industry network and result in change, thus supporting the sustainable innovation to be commercialized.

Third, in the *practice approach*, change emerges through practices and the related norms and rules of the partners in the relationship (Ojansivu et al., 2020). Taking this approach means that the focus shifts from actors and structures toward duality; forces of change are not imposed by the will of conscious actors, but they are present in things and human situations. In our study, practice refers the conscious and unconscious ways of operating; the "view 'behind' the action of the actor" (Ojansivu et al., 2020: 5).

METHODOLOGY

Qualitative research methods are applied to examine the phenomenon of triggering change in an industry network for the commercialization of a sustainable innovation in the empirical context of food packaging. Qualitative methods emphasize the qualities of the entities and thus they enabled the researchers to describe, understand and explain holistically the interactions, processes and meanings that form real-life interorganizational settings (Denzin and Lincoln, 2008: 8; Gephart, 2004). The innovation in question is a new bio-based biodegradable plastic material, intended primarily for packing fresh food products.

The examined new material is developed in a publicly funded R&D project network that includes universities and other research institutions, non-profit organizations, SMEs and larger enterprises. The project aims at both achieving scientific results by scaling-up, validating and demonstrating the new packaging film, made from agro-food waste, and thereafter bringing this invention to the market. There is already demand for more sustainable packaging materials for fresh food, but very few firms offering them and with limited properties. However, the project members lack the skills for further business and product development and the capacity of producing the material in large-scale. Furthermore, the large-scale production of innovation in question creates changes to existing food packaging networks (e.g., new actors to provide new raw materials), and thus the created packaging material is a good example of sustainable innovation, through which the change triggering in an existing industry network to enable its dissemination and further the sustainability transition can be explored.

The data was acquired through 16 thematic interviews with 23 informants from firms and organizations participating in the R&D project and in the food packaging networks. The interviewees were experts on sustainable packaging material development, bioplastics or food packaging. The interviews included single and group interviews, lasting from 30 to 90 minutes. Thematic interviews were perceived as suitable as they facilitated the interaction between the interviewer(s) and interviewee(s) and permitted the researchers being more flexible; emphasing different themes depending on the interviewee's expertise and asking follow-up questions, if

needed. However, each interview included questions regarding 1) the events, developments, and participants of the value network linked to the R&D project as well as the related industry networks, 2) the barriers of commercialization for the innovation in question, and 3) the factors promoting its use.

During the preliminary analysis, in which one researcher analysed half of the interviews and one the other half, it became evident that the data was saturated; the initial coding of the data provided the same results for both researchers. Importantly, the initial coding showed that the research question can be answered in-depth. After the initial coding, the analysis continued inductively identifying the changes that have already happened and the changes that are on the way or might be on the way in the future. The changes were then categorized by identifying whether the change emerged or would emerge through agency, structure or practice. At this phase, the categorization for the changes and their order of appearance was made by two of the researchers first separately and then the findings were compared, and potential triggers were identified. Any differences were discussed and solved so that there was agreement on how to categorize the findings. After this, the findings were discussed together with all researchers. Furthermore, the dynamics between the identified changes were analysed to understand how the change is triggered in existing industry networks. Again, the two researchers drafted the interactions first separately, and then the drafts were compared and discussed by all researchers. The categorizations and drafts made by the two researchers separately were close to each other and there were no significant disagreements. At this phase, also theoretical conclusions started to emerge, which were discussed by all researchers.

EMPIRICAL ANALYSIS

Based on our data regarding the commercialization of the new bioplastic in the food packaging industry network, there appears a complex set of past, planned and anticipated changes that are highly connected to each other. However, as these changes were further analyzed, we were able to suggest an ordered grouping for these changes (Figure 1).

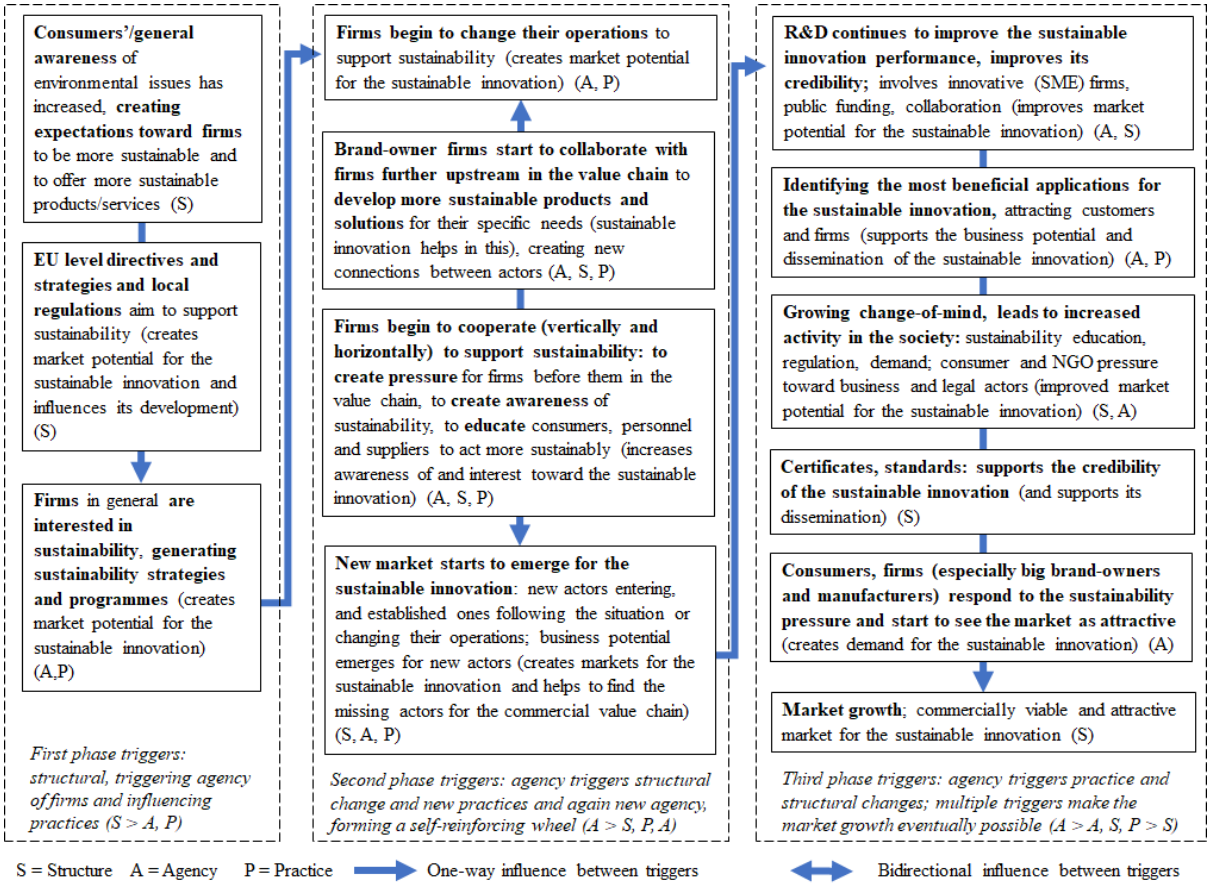

Figure 1. Categorization of the triggers.

We identified triggers that enable other changes to emerge, which again trigger further changes and make possible the emergence and development of new markets for more sustainable products and materials. Altogether, we identified three phases in this change and accordingly, categorized the triggers into first-, second- and third-phase triggers.

The data indicates that *first-phase triggers* are primarily structural changes. An example of such change is the increase in the awareness of sustainability issues that facilitates the emergence of the agency in individuals, firms and governmental actors, and thus initial change in practices. For example, regional, national as well as international governmental actors are increasingly creating sustainability initiatives and preparing structural changes that influence the industry through laws and regulations in order to support sustainability (e.g., EU's plastics strategy). Furthermore, the increase in awareness has triggered consumers to become interested in the environment and thus environmental-friendly products and services, and firms providing them. These changes have further triggered the agency in firms; that is, firms are increasingly creating sustainability strategies and programmes to become more sustainable and searching for more sustainable alternatives to their products and materials to answer to the tightening regulations and the high expectations of consumers. The structural triggers thus make the actors in the network aware of the situation and gradually trigger new agency and practices.

The *second-phase triggers* identified from the data emerge primarily from the agency of firms, which is triggered by the shown structural changes and which enables the actors to make changes to their internal and inter-organizational practices; that is, to turn their interest into real actions that influence the emergence of new sustainability markets. In the food industry, there are proactive firms that have been and are making changes to their operations, offerings, and processes to support sustainability and alluring others to joint this movement. For example, brand owners are increasing their cooperation with firms in the up-stream of the value network (especially packaging suppliers), and broadening this cooperation to include new partners even further in the upstream (plastics providers), in order to develop sustainable products and materials for their needs or changing their products to more sustainable alternatives. This cooperation supports the transparency of product and process information through the value network, which is critical for a sustainable innovation to be credible, but which currently is a problem. In addition, brand owners cooperate vertically and horizontally to create stronger pressure for up-stream firms in the value network (especially plastics providers), and to educate their suppliers, their own personnel, and consumers to act sustainably. Brand owners cooperate with environmental associations and universities in sustainability education, and they are hiring material experts to be able to practice sustainable purchasing of packaging and products. Thus, agency influences the structure of the industry network by forming new relationships between actors and making changes to practices to fulfil their sustainability targets. This again triggers stronger agency, creating a self-reinforcing wheel when successful (the bidirectional arrow in Figure 2). As a result of these second-phase triggers, the food packaging industry networks are undergoing changes to become more sustainable and the market for bioplastics in this context is emerging.

However, in order to turn this emerging market into a commercially viable and growing market, which attracts a wide group of firms to join (e.g. the large established firms), the data reveals that the performance of the sustainable innovation must improve. Bioplastics are still characterized by poorer product properties than conventional plastics, which hinder the interest of brand owners to start packing their food products in them. The *third-phase triggers* thus include, for example, the continuing R&D required to improve the performance of sustainable solutions. However, this work needs to be carried out in growing terms by private actors, although public funding still plays a critical role, when the market is just emerging. This shows the importance of agency needed to increase the credibility and attractiveness of bioplastics in food packaging. The upcoming regulations related to reducing the use of less sustainable packaging materials, for example, are triggering more firms and other actors to develop and adopt sustainable innovations. If the new material development takes place in a publicly funded R&D project network that lacks skills and production capacity to bring their inventions directly to the market, as it is in our data, small and innovative material development firms play an important role in making this change towards a growing market to happen, as large established firms have been reluctant to answer the specific needs of the food industry. This trigger is already in action, as small and medium size innovative R&D firms have been facing and eager to answer the growing demand for sustainable packaging and products in various sectors. Another key trigger relies on agency; firms need to find applications, in which the sustainable

innovation will bring the most distinctive benefits. Without this, the market attractiveness stays low and the role of regulation as a structural trigger grows.

Other problem related to turning the emerging sustainability market into a growing and attractive market for new actors to enter relate to the lack of knowledge on sustainable materials and solutions. Therefore, agency is needed by various actors (e.g., regulators, brand owners, NGOs, non-profit associations) to actively increase the awareness of sustainability issues and materials as well as to support the credibility of such innovations. In addition, certificates and standards could help increase the credibility of the sustainable innovations in the eyes of the consumers and firms alike. Now the sustainability claims made by firms remain unclear and without evidence in many cases. When the performance and credibility of sustainable innovation improve, and applications with real benefits are identified, the market can become more attractive to a larger group of firms, making market growth possible. Thus, agency is a major trigger in this phase, too, creating structural and practice changes and new agency, which possibly facilitate the growth of a market. This increases the odds for commercializing the sustainable innovation, as compared to the phase of an emerging market, when it is still unsure, whether there will be viable business opportunities or not.

CONCLUSIONS

This study contributes to the exiting discussion on sustainability transitions (Köhler et al., 2019) and understanding of commercializing of sustainable innovations (Smith, Voss and Grin, 2010). Recently, there has been increasing demands to create understanding of how sustainable innovations can be enhanced in collaborative networks consisting of actors from both public and private sectors (Lupova-Henry and Dotti, 2019). This study suggests that to mobilize change in an industry network, diverse triggers that facilitate the emergence and growth of a market for a sustainable innovation in the food packaging play an important role. The study provides a holistic approach to understanding the change required in sustainability transitions.

First, our findings indicate that structural changes create the first wave of sustainability transition by triggering the agency. The agency then changes and creates practices that lead to structural changes in industry-wide – an emerging market for the sustainable innovation. This phase includes interaction and relationships between a multitude of actors, both horizontally and vertically. Although the agency has the power to trigger the change initially, the change also necessitates alluring other actors to join the change. Our findings in this regard are in line with existing research acknowledging that sustainability innovation diffusion, rather than being a firm-driven linear process, is a multi-actor and multi-level phenomenon (Trischler et al., 2020). In order to turn the emerging market into a growing and attractive market, wider structural changes to industry are triggered by continuing R&D that improves the performance and credibility of the sustainable innovation into the level that more actors gain business opportunities by it and the most importantly, the large established firms become interested in joining the sustainability transition. This results in finding suitable applications for the innovation, and the larger market to perceive the innovation as credible and attractive. The presented phases resonate with the developments from an innovation network to an application net (Möller and Rajala, 2007), although the focus here is not on illustrating the relationships

between actors. Furthermore, we argue that it is possible to have this type of development without a hub firm, when the structural triggers encourage groups of firms to work around the innovation and to find the viable applications for it; broad enough agency appears. However, the structure is influenced by agencies, thus creating again changes in structure. Reinforcing interactions between agency, structure and practices create thus first the emerging, and later the growing market for the sustainable innovation.

Second, the present study further increases the understanding of the commercialization of sustainable innovations by showing how structural triggers play an important role in each phase because they can create changes that largely affect the market potential of the innovation (regional and local regulations, pressure from the society, public funding etc.). Specifically, the societal pressure to act sustainably, and thus to develop and adopt sustainable innovations, marks this empirical context. Public funding for continuing the development of sustainable innovations while their market attractiveness is not yet high and performance is not good enough, is key in making the market growth possible. Furthermore, credibility is important with sustainable innovations because besides of being functionally credible, such innovations must be credible in terms of sustainability parameters. Communicating the value of sustainable products is however complex as it involves lots of sustainability-related know-how, which tends to evoke strong emotions. Thus, the increase in the awareness of sustainability issues is a structural trigger that pressures firms to make changes in their practices, but at the same time creating practices that increase this awareness change societal structures and enables firms to act more sustainably.

Our conclusions are a simplification of complex connections between different triggers. However, our aim was to group the triggers in order to examine the logic between them instead of detailed presentation of their connections. A further study would be needed to identify the connections between the triggers.

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